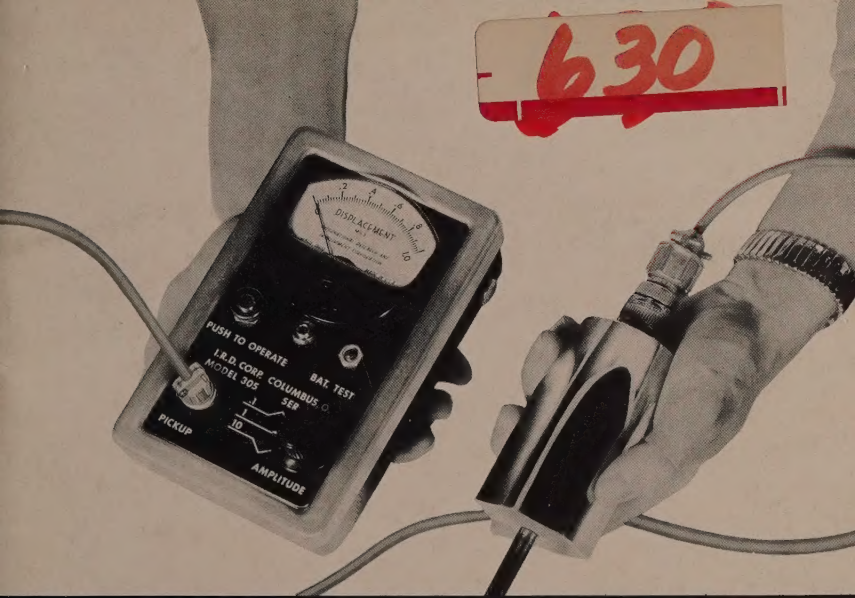

OPERATION AND MAINTENANCE

MANUAL

IRD

Self-Powered
Portable
Vibration
Meter

MODEL 305

Use the 306 (Pre B) Manual
for Calibration

International Research & Development Corporation is making available to industry electronic tools for practical and economical solutions of vibration and balancing problems. Our engineering and research departments are constantly developing new tools and instruments to solve other industrial problems through the science of electronics, though problems of true dynamic balance in industry are our first concern.

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WARRANTY

International Research and Development Corporation warrants that each unit is free from defects in materials and workmanship. Any unit that is returned to our plant during the first year of use will be given any necessary repairs at no cost except battery replacement, vacuum tube replacement or shipping costs.

The warranty does not apply if the unit is subjected to abnormal usage.

IRD

MODEL 305

Portable Vibration Meter

INTRODUCTION

IRD Model 305 Portable Vibration Meter constitutes a rugged, accurate and reliable instrument designed to detect and measure vibration. Self-powered and completely portable, this instrument derives its advantages from the use of sub-miniature tubes, mercury batteries, and printed circuit. Summarily, this instrument affords versatility, sensitivity, and simplicity of operation.

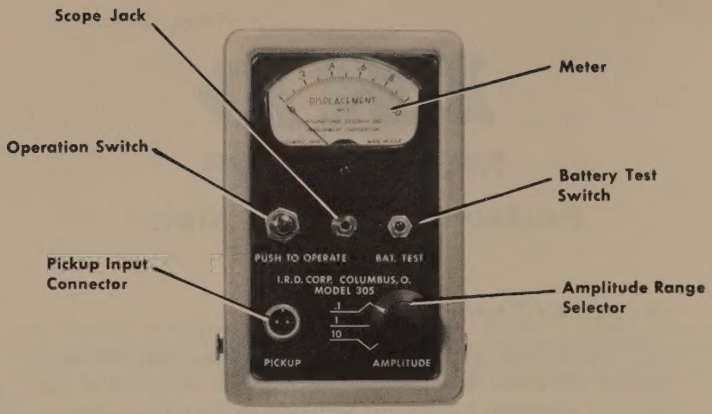
DESCRIPTION

Model 305 Portable Vibration Meter basically consists of a vibration pickup, an amplifier system, and an amplitude meter. The meter is enclosed in a case also containing a printed circuit, sub-miniature tubes, mercury batteries. The front panel contains a battery test switch, a pickup input connector, an amplitude range selector, an operation switch, and a scope jack outlet. The physical dimensions of the case are:

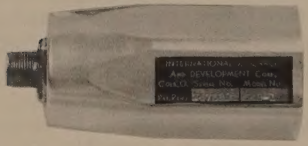
Size: 6½″ x 4″ x 2½″

Weight: 24 ounces (including batteries)

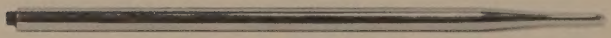
The oil-damped vibration pickup (inductive velocity type) IRD Model 545 is a rugged unit designed to withstand the rigors of industrial usage without impairment to calibration or sensitivity. The pickup responds only to vibrations in the direction of the probe. Transverse response is less



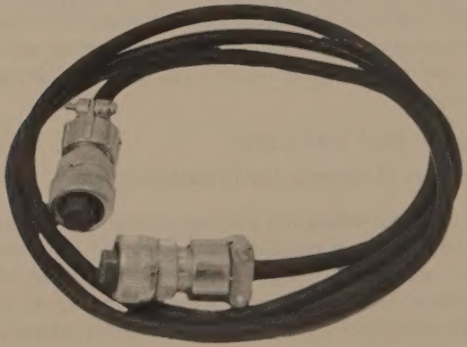
AMPLITUDE METER



PICKUP



PROBE



CABLE

than 5% below 100 cps. A four-foot pickup cable is provided with the unit. Longer lengths are available. The specification of the vibration pickup are:

Dimension: 2¼" diameter by 5⅝" length (including connector)

Weight: 20 ounces

Temperature Range: 60° F. to 110° F. case temperature

Linearity: ±5% (20 cps to 150 cps); +5% (150 cps to 500 cps); —30% (150 cps to 500 cps)

Sensitivity: 1260 millivolts peak per inch per second; 280 millivolts RMS at .001 inch peak-to-peak displacement at 100 cps.

The amplifier system is capable of indicating the peak-to-peak displacement with any velocity transducer (other than the pickup included with the system) which has a minimum velocity constant of 600 millivolts per inch per second peak, and a maximum output impedance of 8000 ohms (resistive), constant over the frequency range of 10 cps to 2000 cps (cycles per second).

The amplitude meter is graduated from 0 to 1, each major graduation being divided into five sub-graduations to provide greater accuracy in reading. The amplitude range selector switch permits three amplitude ranges:

.1 = 0 to 0.1 mil peak-to-peak displacement full scale;
1 = 0 to 1.0 mil peak-to-peak displacement full scale;
10 = 0 to 10.0 mils peak-to-peak displacement full scale.
(One mil is equivalent to one thousandth of one inch.)

An internal gain adjustment is provided for calibration purposes. A dust cover houses the gain control, thereby

minimizing the opportunity for inadvertent adjustments.

Long-life mercury batteries generate the power required to operate this metering system. Fig. 1 shows the location of each battery. Battery part numbers are:

"A" — One RM-415 "Mallory"

"B" — Two RM-12R "Mallory"

In cases of emergency, replace RM-12R "Mallory" by 915 "EverReady" and RM-415 "Mallory" by 415 "EverReady."

The anticipated life of the mercury batteries is 60,000 measurements (on the basis of 10 seconds per measurement) with an off-on duty cycle of not more than 50% (measuring time equal to or less than the non-measuring time).

The specifications on the Model 305 amplifier system are:

Amplitude Range: 0 to 10 mils peak-to-peak displacement on three ranges of 0.1, 1.0 and 10 mils full scale reading.

Accuracy: ±3% over the vibration frequency range of 12 cps to 1000 cps, with an operating

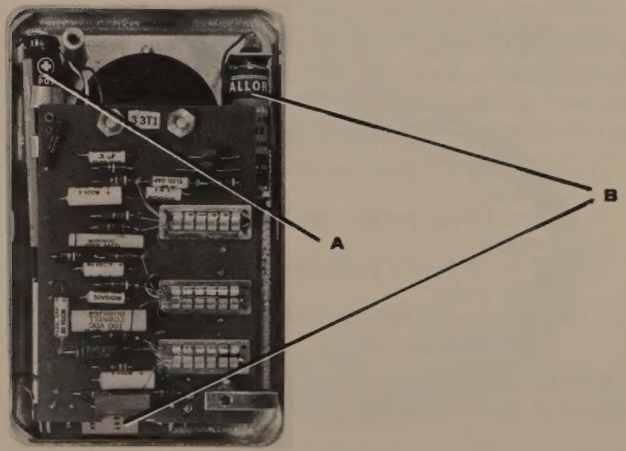


FIGURE 1

ambient temperature of 60 degrees F. to 70 degrees F.

$\pm 10\%$ over the vibration frequency range of 10 cps to 2000 cps, with an operating ambient temperature of 32 degrees F. to 120 degrees F.

Input Impedance: 100,000 ohms

Maximum Sensitivity: 0.2 millivolts/cps for full scale indication on the most sensitive range.

OPERATION

IRD Model 305 is a portable vibration meter designed to detect and measure the peak-to-peak vibration displacement. (See Figure 2).

The principle of operation of this instrument is as follows:

The vibration pickup transforms the mechanical vibration being observed into a corresponding electrical signal whose voltage is directly proportional to the amplitude of the vibration. This signal is then registered on the amplitude meter, thereby giving the displacement in mils.

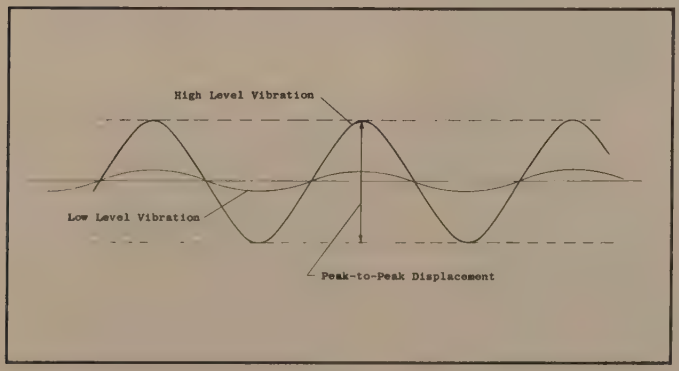


FIGURE 2

Operation of Model 305 Vibration Meter consists of these four easy steps:

Step 1 Test batteries by depressing battery test switch; amplitude meter should read between .8 and 1.0. When meter reads less than .8, replace batteries (see battery replacement, page 17).

Step 2 Plug in one end of pickup cable to pickup and the other end to input connector on front panel of case and attach probe to pickup.

Step 3 Apply vibration pickup to the housing of the part whose vibration is to be measured.

Step 4 Set amplitude range selector to least sensitive position (10). Depress push-to-operate button and take reading. If meter reading is less than .1, change amplitude selector to the next position (1) and repeat operation. If meter reading is still less than .1, change selector to the next position (.1) and obtain reading.

Because the batteries lose some power after repeated operation, an adjustment must be made to compensate this loss. The easiest method is to divide the amplitude reading by the battery test reading. For example, if the amplitude is 5.4 mils and the battery test is .9, the corrected amplitude reading will be $\frac{5.4}{.9} = 6$ mils.

> **Note** Never press operation switch and battery test switch simultaneously because one switch will counteract the other.

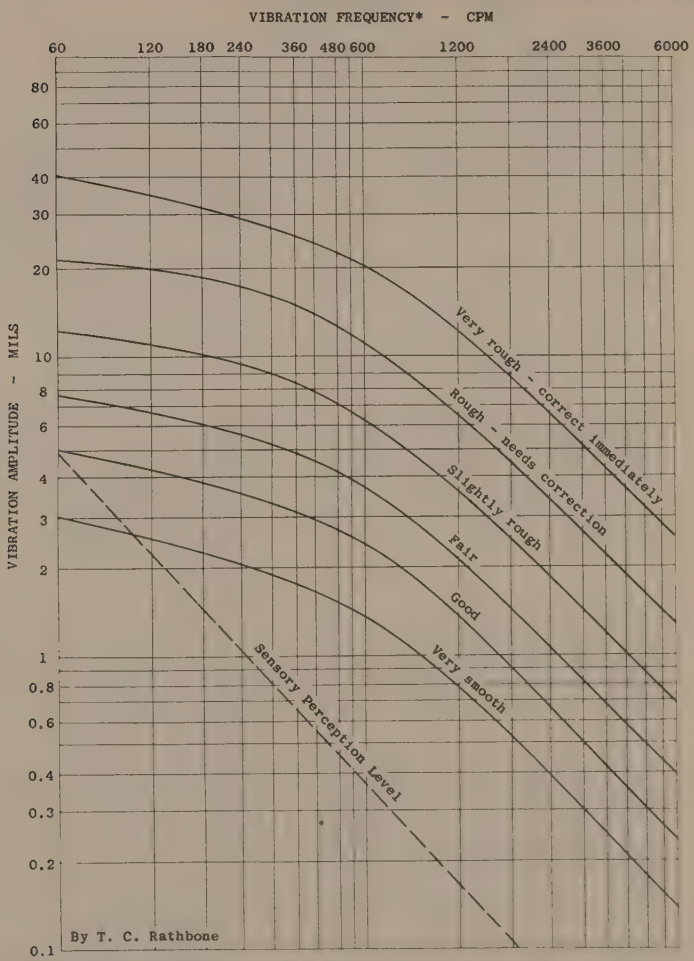
In checking rotating parts, readings should normally be taken perpendicular to the axis of rotation. Furthermore, in making repeated checks over a period of time, measurements should be made at the same point, in the same direction, and under the same operating conditions of the machine.

When checking lightweight parts on which hand pressure might affect the vibration of the part, always be careful not to apply any more pressure than is necessary to prevent chattering of the probe.

If there is more than one Model 305 in use, always use the same pickup with the same meter in order to benefit from the calibration set at the factory. (Record serial numbers in blanks provided on page 30 of this booklet). In case of emergency, a different pickup may be used but the difference in calibration should be taken into consideration.

An oscilloscope may be connected to the scope jack outlet to visually study the vibration waveform in cases where a more detailed analysis is desired. The waveform observed is the velocity output of the vibration pickup.

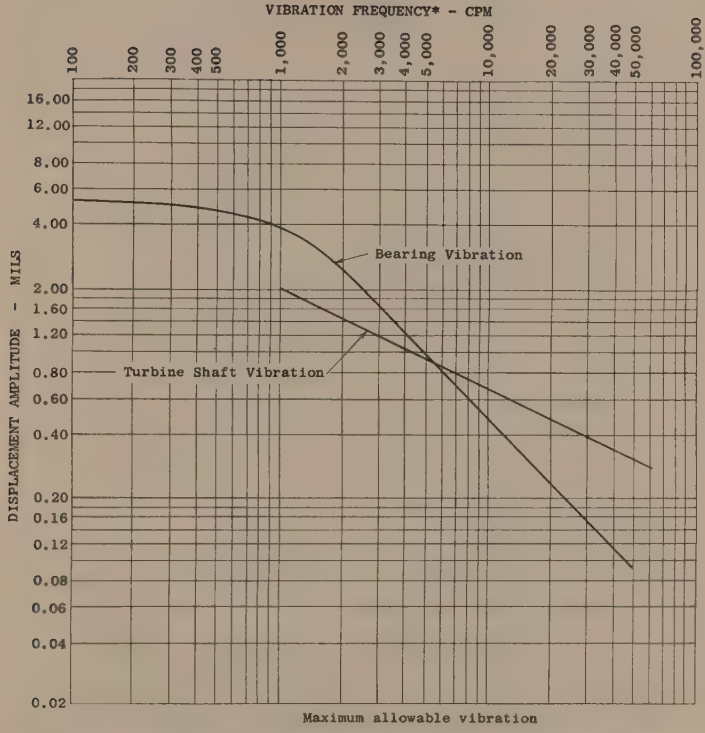
Charts illustrating the approximate degree of



* Frequency corresponds to RPM when dynamic imbalance is the cause of vibration

The values of this chart (by T. C. Rathbone) are based on practical data obtained from a large number of machines and are only an approximate guide. Wide variations from these values may be expected from individual machines.

vibration which can be tolerated on machinery.



* Frequency corresponds to RPM when dynamic imbalance is the cause of vibration

The values on this chart are for shipboard equipment as noted in MIL-STD-167 (SHIPS) 12/20/54. The vibration levels are much too excessive to be applied to precision machine tools and equipment and should definitely not be used for such machinery.

APPLICATION

IRD Model 305 Portable Vibration Meter is designed to detect and measure vibration displacements in various fields of application such as preventive maintenance, incoming inspection, quality control, sales, field service, etc. The instrument can be used easily in each field without any specific training on the equipment.

The standard application method consists of the following:

> Charts are drawn up (see Figure 3) showing the location of the rotating components of a machine, the vibration tolerances at each location, and allowing space to record the data obtained. A comparison with the established tolerances or with recorded reading indicates the status of the machinery. When a high level of vibration is indicated on a machine, an IRD Vibration Analyzer can be brought in to troubleshoot the machine and performs in-place dynamic balancing. (See pages 22-23 for listing of various IRD Vibration Analyzer models.)

To illustrate the above described method, and the flexibility of this instrument, consider the case of a major machine tool manufacturer:

a) Maintenance men take periodical vibration readings with Model 305 and compare the results with their standards. If vibrations are excessive, they are able to plan the repair or replacement of the affected parts at an opportune time.

b) The receiving department checks each purchased component with this instrument and rejects those with high-level vibration before they are assembled in the finished product.

c) Periodic vibration checks of production machines permit the detection of any high-level vibration which might alter the quality of the machined product. This method minimizes the amount of rejects which occur when a finished product has to reach final inspection before a malfunction may be detected.

d) Quality control inspectors carry this model anywhere on the production line to insure that the product is within vibration tolerance standards.

e) Outside the plant, field servicemen use this instrument to troubleshoot any machinery anywhere in the field because it does not require outside power source and can be carried in a car, a tool chest, or even in a briefcase.

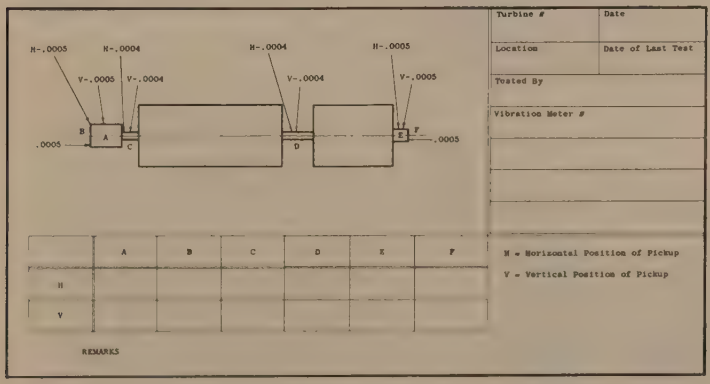
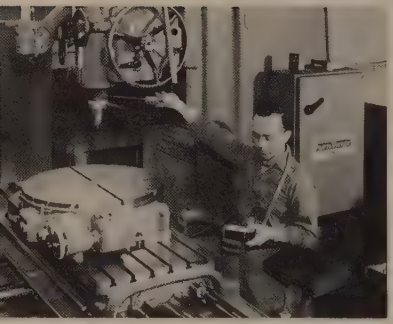
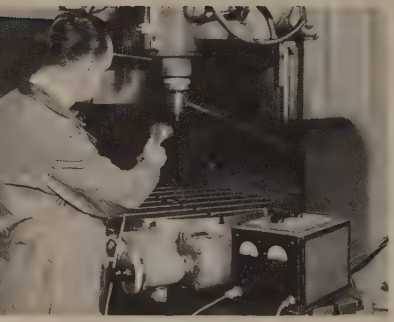


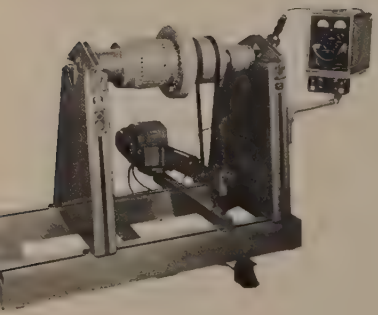
FIGURE 3



CHECKING Jig Boring machine is inspected with Model 305 to check for an acceptable or not acceptable vibration level — the key to its efficient operating condition.



TROUBLESHOOTING Once the 305 establishes the presence of high vibration, a Vibration Analyzer and portable balancer such as Model 400 is brought in to pinpoint the cause and correct it — without costly dismantling of machinery.



IRD DYNAMIC BALANCING SYSTEM When it is required to balance a disassembled component such as this rotor, the portable analyzer is a part of a complete dynamic balancing system. Here, IRD Vibration Analyzer is used in conjunction with Model 102 Dynamic Balancing System.

MAINTENANCE

IRD Model 305 Portable Vibration Meter normally requires no mechanical maintenance. There are no lubrication points. Battery replacement is the only normal maintenance required.

To replace batteries, remove back cover of case by loosening two screws. Replace batteries, carefully matching the polarity as indicated on the base of battery holders.

Replace batteries "A" by RM-12R Mallory, and battery "B" by RM-415 Mallory. In case of emergency replace:

"A"—RM-12R Mallory by 915 EverReady
"B"—RM-415 Mallory by 415 EverReady

In any event, replace batteries once per year. When any other malfunction occurs, return complete unit with pickup to the factory. The vibration pickup should always be returned to the factory to be repaired.

A circuit description, wiring diagram, parts list and tube layout appear in this manual which can serve as maintenance data for the users who have the necessary trained personnel and equipment to service this instrument.

• CIRCUIT DESCRIPTION

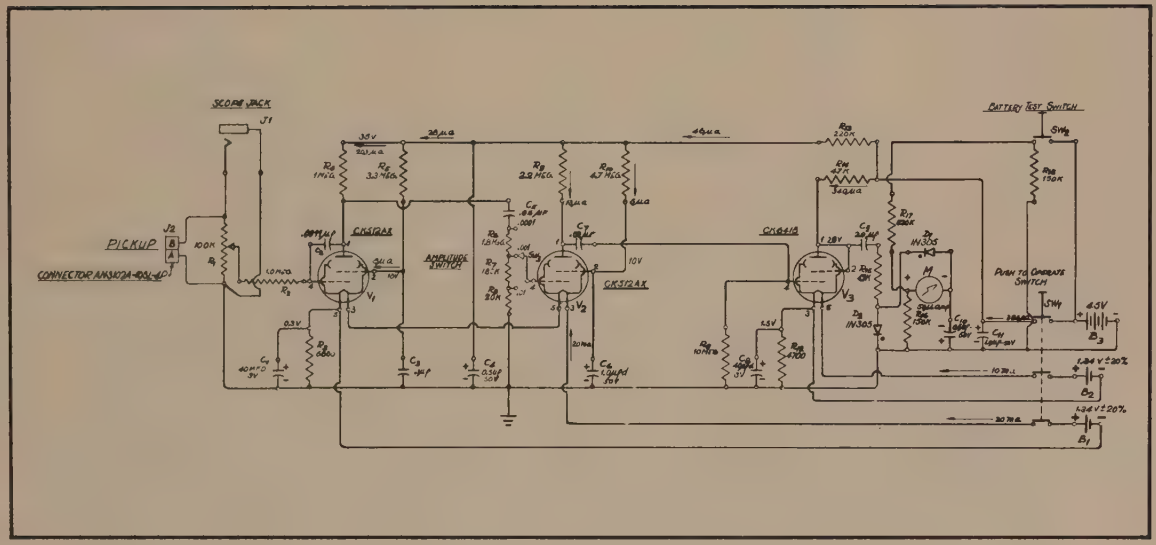
The IRD 545 transducer used with Model 305 is terminated into an input load of 100,000 ohms (R_1). The signal output of R_1 is then applied to V_1 which is the linear electronic integrator. Integration is performed by the signal at the plate of V_1 being fed back to grid 4 of V_1 through condenser C_2. The amount of feed-back voltage through C_2 is determined by the R_2 - C_2 time constant.

The output of V_1 is then fed to the amplitude switch SW3 which determines the range of operation. The grid of V_2 is fed by the arm of SW3. V_2 is a voltage amplifier which, in turn, drives the grid of V_3. V_3 is the power tube driving the amplitude metering circuit. D_1 and D_2 rectify the sinusoidal wave from the plate of V_3. The rectified voltage is filtered by C_{10} and R_{16} producing an average DC component which drives meter M. Peak-to-peak reading on meter M is preset by R_1.

Scope Jack A tiny plug pin jack can be inserted in scope Jack J1. The scope used to observe the sinusoidal electrical component vibration is fed back to 100 K potentiometer (R_1). A high impedance linear scope should be used.

Push-to-Operate Switch B_1, B_2 and B_3 are in open circuit condition when push-to-operate switch is undepressed. When switch is depressed, B_1 and B_2 supply the required filament power to V_1, V_2, V_3, and SW2.

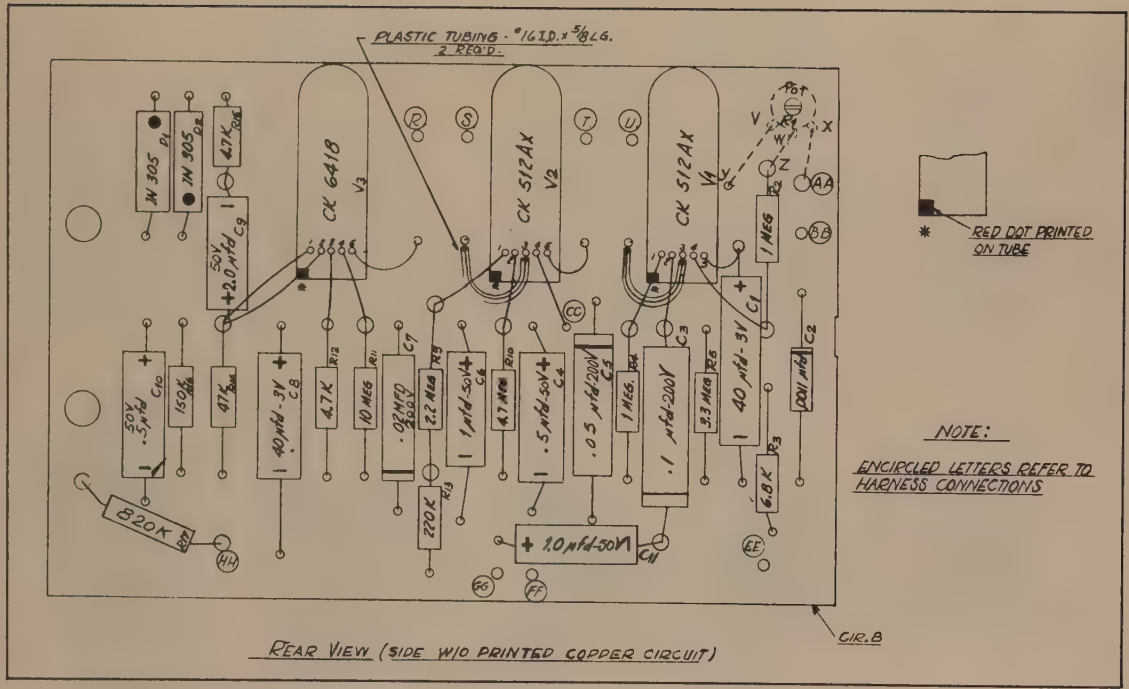
Battery Test Switch When battery test switch SW2 is depressed, B+ voltage is applied to R17, R18, and to the metering circuit. The resistance values are such that full-scale deflection of meter M is made with a new "B" battery. Meter M deflection decreases as the voltage of B_3 decreases through normal usage discharge, thus meter M deflection determines battery conditions.



SCHEMATIC • IRD Model 305 Vibration Meter

• PARTS LIST

Circuit Symbol	Description	Mfg.
R_1	100K Ω Miniature Potentiometer 48-9-100K	Clarostat
R_2	1.0 Meg, ½ W, 5 % "Little Devil"	Ohmite
R_3	6.8K ½ W, 5 % "Little Devil"	Ohmite
R_4	1 Meg, ½ W, 5 % "Little Devil"	Ohmite
R_5	3.3 Meg, ½ W, 5 % "Little Devil"	Ohmite
R_6	1.8 Meg, ½ W, 1 % DCC ½ W "Precistors" 1 %	I.R.C.
R_7	180K ½ W, 1 % DCC ½ W "Precistors" 1 %	I.R.C.
R_8	20K ½ W, 1 % DCC ½ W "Precistors" 1 %	I.R.C.
R_9	2.2 Meg, ½ W 5 % "Little Devil"	Ohmite
R_{10}	4.7 Meg, ½ W 5 % "Little Devil"	Ohmite
R_{11}	10 Meg, ½ W 5 % "Little Devil"	Ohmite
R_{12}	4.7K ½ W, 5 % "Little Devil"	Ohmite
R_{13}	220K ½ W, 5 % "Little Devil"	Ohmite
R_{14}	47K ½ W, 5 % "Little Devil"	Ohmite
R_{15}	4.7K ½ W 5 % "Little Devil"	Ohmite
R_{16}	150K ½ W 5 % "Little Devil"	Ohmite
R_{17}	820K ½ W 1 % DCC ½ W "Precistors"	I.R.C.
R_{18}	150 ½ W 5 % "Little Devil"	Ohmite
C_1	40 mfd, 3V Series C Miniature Electrolytic	I.E.I.
C_2	.0011 mfd 500V, 15 % 5A5D1 "Super Micadon" Mica	C-D
C_3	.1 mfd, 200V P92ZN	Aerovox
C_4	.5 mfd, 50V Series A Miniature Electrolytic	I.E.I.
C_5	.05, 200V P92ZN	Aerovox
C_6	1 mfd, 50 V Series B Miniature Electrolytic	I.E.I.
C_7	.02 at 200V P92ZN	Aerovox
C_8	40 mfd, 3V Series C Miniature Eltcrolytic	I.E.I.
C_9	2.0 mfd, 50V Series BB Miniature Electrolytic	I.E.I.
C_{10}	.5 mfd, 50V Series A Miniature Electrolytic	I.E.I.
C_{11}	1 mfd, 50V Series B Miniature Electrolytic	I.E.I.
SW1	3 POL, Single Throw, N.O. Contacts, Acro #260-0019-00	Acro Mfg. Corp.
SW2	Momentary contact miniature switch N.O. Model 30-1 (Red Butt.)	Grayhill
SW3	Single pol — 3 pos. shorting contacts 24YY2100-3 Series 24	Grayhill
D1	IN305 Germanium Rectifier	Raytheon
D2	IN305 Germanium Rectifier	Raytheon
M	50 amp ammeter	Marion
R_1	1.35 VDC Mercury "A" battery RM-12R	Mallory
R_2	1.35 VDC Mercury "A" battery RM-12R	Mallory
R_3	45 VDC Mercury "B" battery RM-415R	Mallory
J1	"Tiny-Jax" #41	Switch Craft
J2	AN3102A-10SL-4P	Cannon



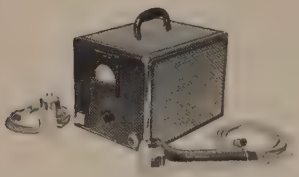
TUBE LAYOUT • Model 305 IRD Vibration Meter

IRD VIBRATION ANALYZERS AND

MODEL 305 Portable Vibration Meter

Basic function: Measuring vibration displacements (double amplitude) from micro-inches to .010 in.

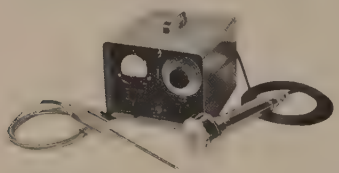
Application: Checking permissible vibration tolerances—the key to satisfactory operation on all types of machinery with rotating components.



MODEL 300 Vibration Analyzer

Basic function: Measuring vibration displacements. Dynamic and single-plane balancing.

Application: Checking permissible vibration tolerances, in-place balancing of blowers, motors, impellers, etc., without costly dismantling. Operating range 600 cpm to 5000 cpm.



MODEL 311 Vibration Analyzer

Basic function: Measuring vibration displacements. Analyzing frequencies with variable filter.

Application: Checking permissible vibration tolerances. Troubleshooting and pinpointing each source of vibration.
In-place balancing without costly dismantling. Operating range 500 cpm to 5000 cpm.

MODEL 400 Vibration Analyzer

Basic function: Measuring vibration displacements and frequencies. Dynamic and single-plane balancing.

Application: Checking permissible vibration tolerances. Troubleshooting and pinpointing each source of vibration.
In-place balancing without costly dismantling.
Operating range 600 cpm to 20,000 cpm.

MODEL 557 Vibration Analyzer

Basic function: Measuring vibration displacements and frequencies.
Analyzing frequencies with variable filter.
Observing vibration waveform.

Application: Checking permissible vibration tolerances in jet engines and associated high speed accessories. Troubleshooting and pinpointing each source of vibration. Operating range 600 cpm to 300,000 cpm.

DYNAMIC BALANCING EQUIPMENT

MODEL 652 Vibration Analyzer

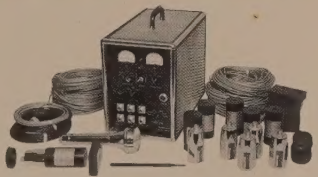
Basic function: Measuring vibration displacements and frequencies.
Dynamic and single-plane balancing.

Application: Checking permissible vibration tolerances. Troubleshooting and pinpointing each source of vibration.
In-place balancing without costly dismantling. Operating range 500 cpm to 40,000 cpm.

MODEL 752 Vibration Analyzer

Basic function: Measuring vibration displacements and frequencies. Dynamic and single-plane balancing.
Tuning to specific frequencies.

Application: Checking permissible vibration tolerances in power house machinery. Troubleshooting and pinpointing each source of vibration. In-place balancing without costly dismantling. Operating range 500 cpm to 10,000 cpm.



MODEL 1065 Continuously Variable Filter

Basic function: Analyzing frequencies in conjunction with any IRD vibration analyzer.

Application: Tuning to various frequencies in machinery in order to study each component as a separate part without dismantling.

MODEL 600 Vibration Analyzer

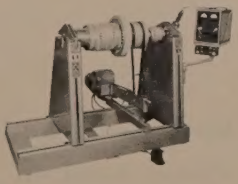
Basic function: Measuring vibration displacements and frequencies.
Analyzing frequencies with variable filter.
Dynamic and single-plane balancing.

Application: Checking permissible vibration tolerances. Troubleshooting and pinpointing each source of vibration. In-place balancing without costly dismantling. Operating range 500 cpm to 160,000 cpm.

MODEL 102 Dynamic Balancing System

Basic function: Dynamic and single-plane balancing.

Application: Balancing disassembled components such as rotors, shafts, flywheels, etc. All IRD Vibration Analyzers used in conjunction with the dynamic balancing system are readily disconnected to afford portable vibration analyzing and in-place balancing.



Meter Serial No._____

Pickup Serial No._____

IRD

INTERNATIONAL RESEARCH
AND DEVELOPMENT CORP.

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COLUMBUS, OHIO